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Galactic boom-and-bust cycle revealed

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New X-ray images of two very distant galaxies have revealed what appears to be a boom-and-bust cycle in the early evolution of galaxies and galaxy clusters.

The images, taken with the orbiting Chandra X-ray observatory, show huge clouds of high-energy particles surrounding two galaxies, 3C294 and 4C41.17. These are located 10 and 12 billion light years away respectively.

The particles can be traced back, using X-ray and radio observations, to jets emanating from supermassive black holes at the centres of the galaxies, and can therefore be identified as the remnants of explosive activity in these early galaxies.

"The galaxies may be revealing an energetic phase in which a supermassive black hole transfers considerable energy into the gas surrounding the galaxies," said Andrew Fabian of Cambridge University, UK, who led the study to be published in the *Monthly Notices of Royal Astronomical Society*.

Unchecked collapse

The finding may help explain some puzzling features of early galaxies and the largest clusters of galaxies, the team says. In particular, it explains why the gravitational accretion of matter does not just continue unabated until all the gas, dust and stars in a region have collapsed into far larger galaxies and much denser galaxy clusters, with more massive central black holes, than are actually seen..

The astronomers suggest that the huge energetic jets implied by new work provided an energetic wind that countered the accretion process and pushed everything outward again. This process is similar to the T-Tauri winds that sweep away all the gas and dust around newly-formed stars.

"It's as if nature tries to impose a weight limit on the size of the most massive galaxies," said Caleb Scharf, an astronomer at Columbia University in New York and author of a separate study on the Chandra findings being published in the *Astrophysical Journal*. The energetic winds, he says, provide a mechanism to regulate the growth of the galaxy by stopping the collapse for a few million years, after which the cycle begins again.

The particular region of space observed by the astronomers has an unusually high density of galaxies. Eventually, all these galaxies and their accompanying gas and dark matter will collapse to form galaxy clusters that, the team says, will be among the most massive objects in the Universe.

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